

foreleg tarsus, the presence of which is diagnostic for the genus *Plebejus* Kluk. The forelegs have been detached and are mounted on a card beneath the specimen."

However, the specimen is identical in other respects to a series in the British Museum (Natural History), London. The series has been taken from two locations, "Tibet, Ta Tsien Lou, ex. coll. Oberthur, 1900" and "Yaregong, 1903", with a forewing expanse of 12-13 mm and identified as *Plebejus eversmanni* (Stgr.). I would suggest that the foreleg spine of the Malari specimen may have broken off at some stage and that it is of the same species as the *Plebejus eversmanni* (Stgr.) series in the British Museum (N.H.). The specimen from Malari did not match any other *Plebejus* Kluk at the British Museum (N.H.).

Lewis (BUTTERFLIES OF THE WORLD, 1974) has illustrated this species which, according to him, occurs in the Pamirs and Turkestan and mentions a similar species, *Plebejus lucifera* (Stgr.) from Tibet

and Mongolia, with the underside markings more distinct. However, Ta Tsien Lou, the location from which several *P. eversmanni* in the British Museum (NH) have been taken, is at 30° 3' N, 102° 10' E, a little over 26° of longitude east of the Pamirs. I was unable to locate Yaregong.

On the basis of the above, I hereby report the occurrence of *Plebejus eversmanni* from Malari in Uttar Pradesh, at present in the collection of the Rev. Alan Bean at the University Museum in Oxford, U.K., with the following data:

Malari, N. Uttar Pradesh, 3000 m. Peter Smetacek, 21 August 1987, SN 8532, slide of genitalia mounted with specimen.

I am grateful to the Rev. Alan Bean for his help in identifying this specimen, to Basil Wirth for photographing it and to Dr. Philip Ackery for permission to compare specimens in the British Museum (N.H.) London.

August 8, 1992

PETER SMETACEK

### 36. CANNIBALISM AMONG IMMATURES OF *PHLEBOTOMUS PAPATASI* (DIPTERA: PSYCHODIDAE)

Cannibalism is one of the biotic interactions among the members of a population to regulate the optimum carrying capacity of the habitat for proper utilization of the available resources (Kerb 1972, Odum 1971). This behavioural trait has also been reported in larvae of certain species of dipterous insects (Shoukry 1980). Extensive studies have been carried out on this aspect in different species of mosquitoes (Corbet and Griffiths 1963). However, the phenomenon has not yet been reported in the immatures of sandflies. Therefore a study was carried out on cannibalism among the immatures of *Phlebotomus papatasi* under different conditions of food availability and density, and the results obtained are presented.

#### MATERIAL AND METHODS

To find out the extent of cannibalism two sets of experiments with five replicates were conducted. Each replicate of the first set of experiments was started with 100 freshly hatched larvae and maintained with standard larval diet, viz. a 1:1 mixture of white clay and rabbit faecal pellets, and that of the second set without any food right from the beginning of the experiment. Observations were made daily and

the number of larvae surviving were recorded until the pupation and emergence. Larvae that were found dead without any injury were categorised as natural mortality. The number of head capsules without exuvium of the body were reckoned as consumed.

To find out the effect of density on cannibalism, freshly hatched first instar larvae of *P. papatasi* were released and reared at different densities, viz. 25, 100, 200 and 400 per container. Containers had a surface area of 7.25 sq. cm. and capacity of 200 ml. The larvae were fed on standard larval diet 'ad libitum' and each set of experiments was replicated three times.

Cannibalistic behaviour was also studied by examining the gut contents. For this purpose a batch of 500 freshly hatched larvae was maintained in a plastic container without providing any food material. About 25 larvae were dissected daily and the gut contents were examined periodically under a compound microscope for the presence of larval parts.

#### RESULTS AND DISCUSSION

Cannibalism was found to occur in both sets of experiments (Table 1). The number of larvae con-

TABLE 1  
NUMBER OF *P. papatasi* LARVAE CONSUMED, DIED AND PUPATED WHEN REARED BATH IN PRESENCE AND ABSENCE OF FOOD

Set	No. consumed Mean $\pm$ S.D.	No. died	No. pupated
I, food provided and libitum	3.3 $\pm$ 0.4 (3-4)	9.3 $\pm$ 1.2 (8-11)	87.3 $\pm$ 1.7 (85-89)
II, no food provided	98.0 $\pm$ 0.8 (97-99)	2.0 $\pm$ 0.8 (1-3)	—

Figures in parentheses denote range.

sumed due to cannibalism in the first set (where food was given 'ad libitum') ranged from 3-4 (mean 3.3  $\pm$  0.4) and the mean number of adults obtained was 87.3  $\pm$  1.7 (range 85-89). The remaining larvae died due to natural causes.

In the second set, where food was not offered, the number of larvae that died due to cannibalism ranged from 97-99 (mean 98.0  $\pm$  0.8). Cannibalism was first observed on the third day of hatching and was seen at every instar. Very few larvae survived (mean 2.0  $\pm$  0.8) and these also perished, when they were 3rd stage in the absence of food. During cannibalism head capsules and caudal bristles were found to be discarded.

The effect of density on cannibalism is shown in Table 2. Cannibalism was observed at all density levels, but was less at low immature density and more at high density. There was a positive correlation ( $r=0.998$ ;  $p=0.0016$ ) between immature density and cannibalism, which suggests that the increase in density was also responsible for cannibalism.

When a total of 500 live larvae was dissected and the gut contents were examined periodically,

TABLE 2  
NUMBER OF *P. papatasi* LARVAE CONSUMED, DIED AND PUPATED WHEN REARED AT DIFFERENT DENSITIES

Density	No. consumed Mean $\pm$ SD	No. died	No. pupated
25	4.0 $\pm$ 1.4 (2-5)	3.3 $\pm$ 1.3 (2-4)	18.0 $\pm$ 1.6 (16-20)
100	37.3 $\pm$ 4.9 (31-43)	7.7 $\pm$ 1.2 (6-9)	55.0 $\pm$ 3.7 (51-60)
200	108.0 $\pm$ 6.5 (102-117)	13.7 $\pm$ 2.1 (11-16)	78.3 $\pm$ 4.9 (72-84)
400	234.3 $\pm$ 7.1 (225-242)	19.0 $\pm$ 5.1 (14-26)	146.7 $\pm$ 4.0 (141-150)

Figures in parentheses denote range.

remnants of larval parts, i.e. exoskeletal structures (matchstick hairs) were seen. This observation also confirms the occurrence of cannibalistic behaviour in this species. The well developed mandibles in II, III and VI instar larvae with serrated margins facilitate seizing and cutting to pieces of the prey.

From the study it is clear that the immatures of *P. papatasi* are cannibalistic even in the presence of food. Though such behaviour is disadvantageous to the immatures, it may help in maintaining the population under unfavourable conditions, i.e. limitation of food.

#### ACKNOWLEDGEMENTS

We are grateful to Dr. V. Dhanda, Director, Vector Control Research Centre, Pondicherry for the facilities provided, and to the technical staff of Rearing and Colonization Division for their technical assistance.

July 7, 1992

R. SRINIVASAN  
K.N. PANICKER

#### REFERENCES

- CORBET, P.S. & GRIFFITHS, A.O. (1963): Observations on the aquatic stages of two species of *Toxorhynchites* (Diptera: Culicidae) in Uganda. *Proc. Entomol. Soc. Lond. Ser. A. Gen. Entomol.* 38: 7-9.
- KERB, C.J. (1972): Ecology: the experimental analysis of distribution and abundance. Harper and Row Publishers, London.
- ODUM, E.P. (1971): Fundamentals of Ecology. W.B. Saunders Company, Philadelphia and London.
- SHOUKRY A. (1980): Cannibalism in *Anopheles pharoensis*. *Experientia* 36: 308 - 309.